FIG. 1

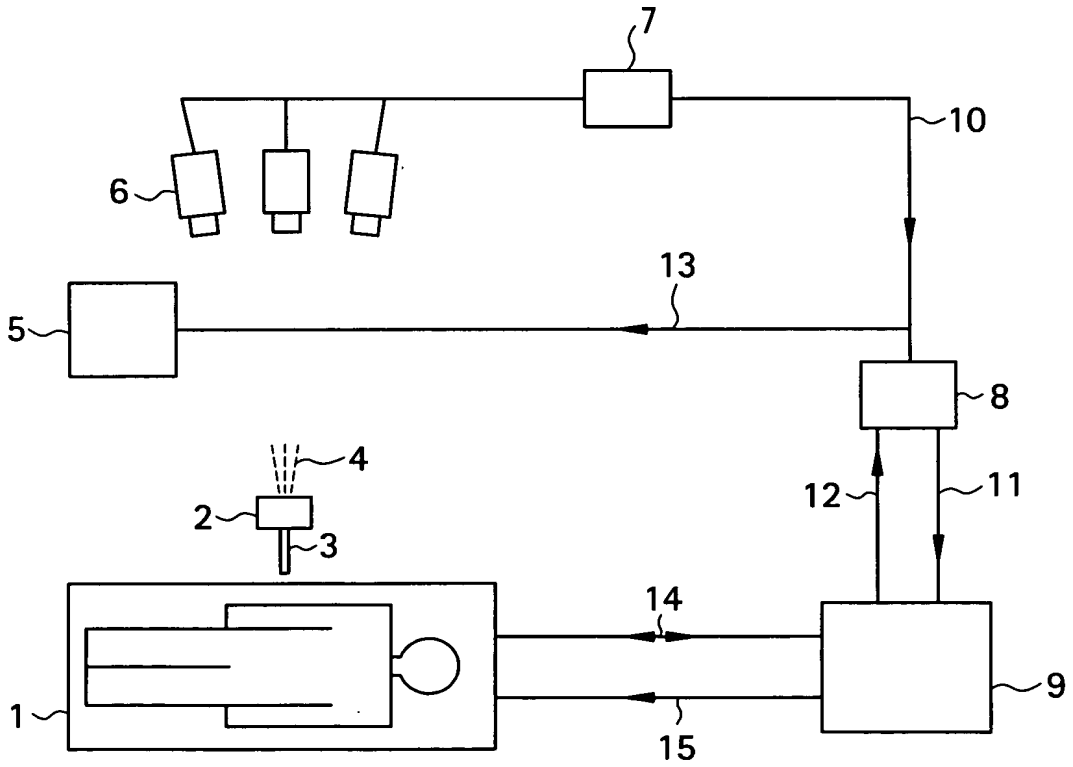

FIG. 2

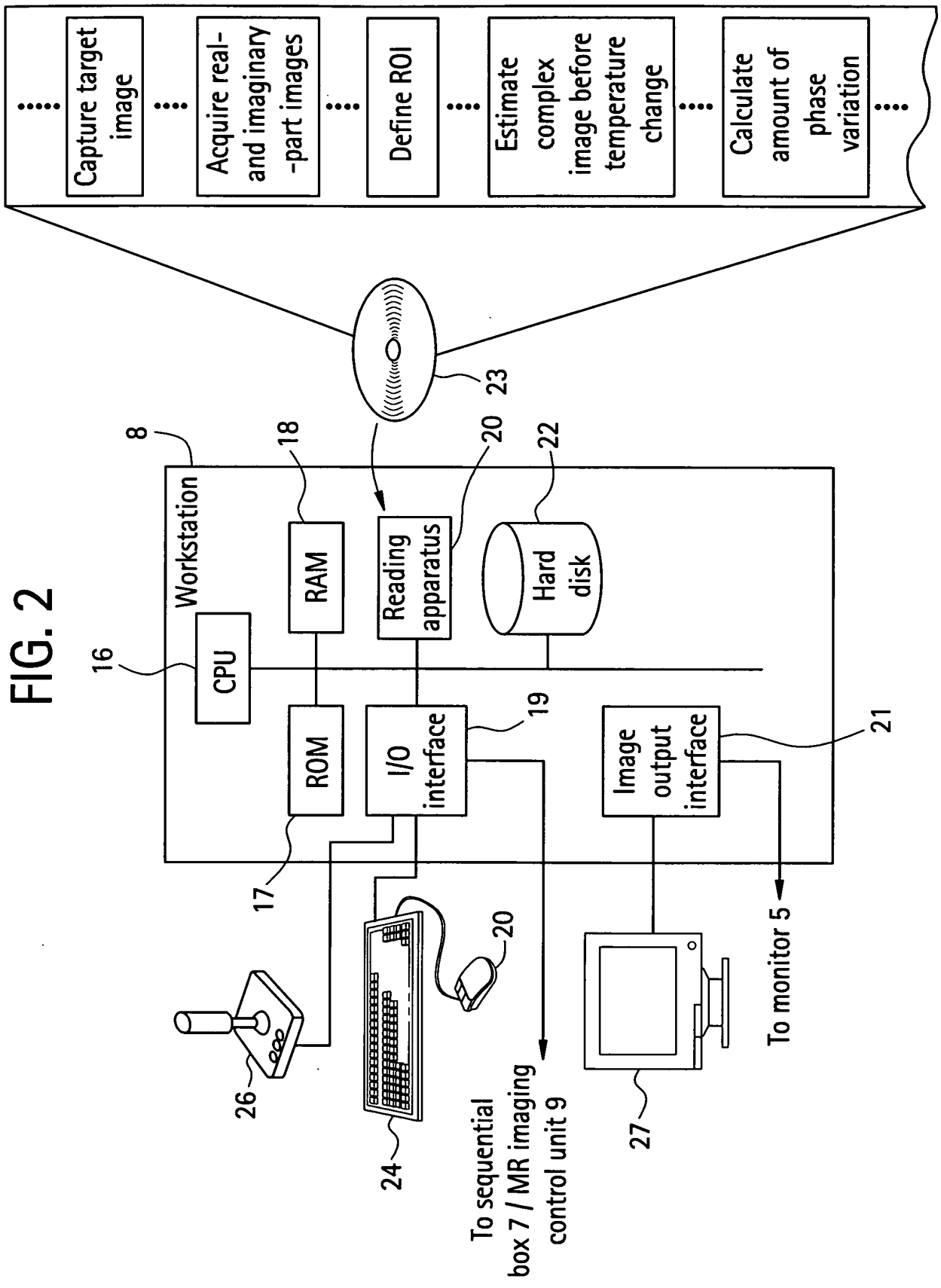
Capture target image
Acquire real- and imaginary -part images
Define ROI
Estimate complex image before temperature change
Calculate amount of phase variation
23
8
Workstation
18
RAM
20
Reading apparatus
22
Hard disk
16
CPU
ROM
17
I/O interface
19
Image output interface
21
To monitor 5
20
26
24
To sequential box 7 / MR imaging control unit 9
27

FIG. 3A

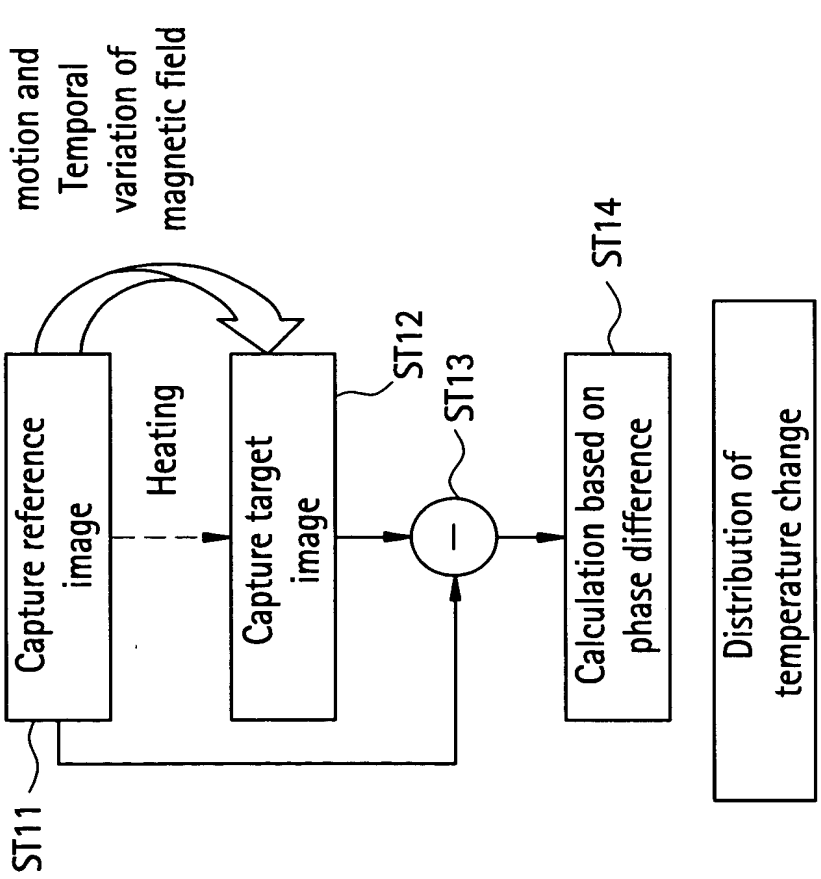
Affected by body motion and Temporal variation of magnetic field
Capture reference image
Heating
Capture target image
ST11
ST12
ST13
ST14
Calculation based on phase difference
Distribution of temperature change

FIG. 3B

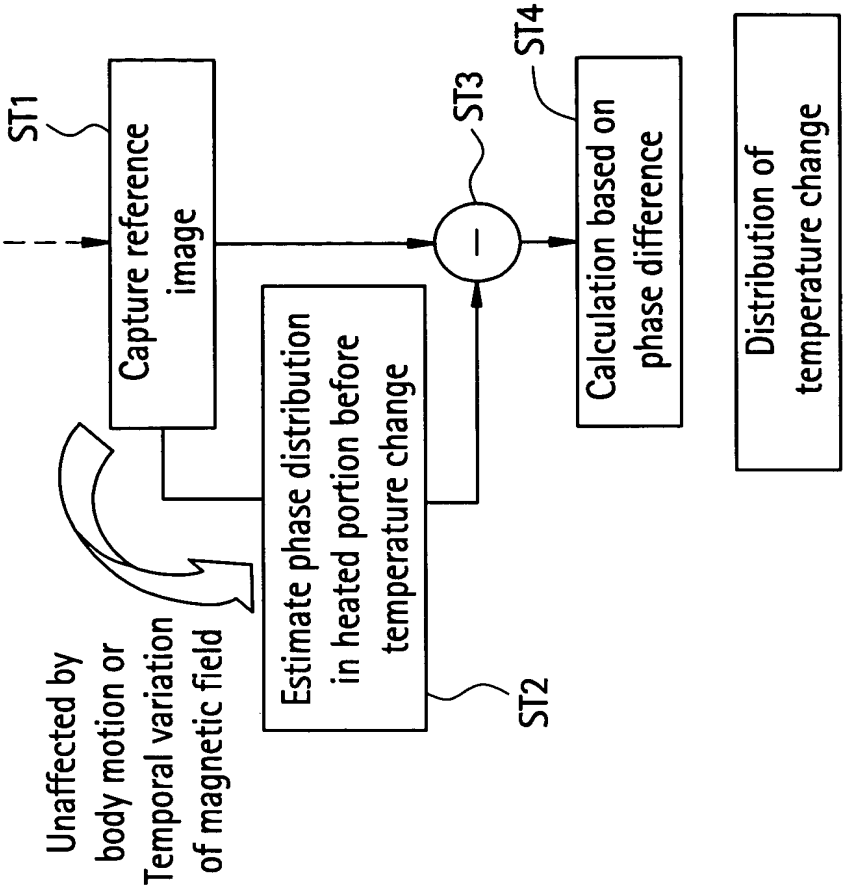
ST1
Capture reference image
ST3
ST4
Calculation based on phase difference
Distribution of temperature change
Unaffected by body motion or Temporal variation of magnetic field
Estimate phase distribution in heated portion before temperature change
ST2

FIG. 4

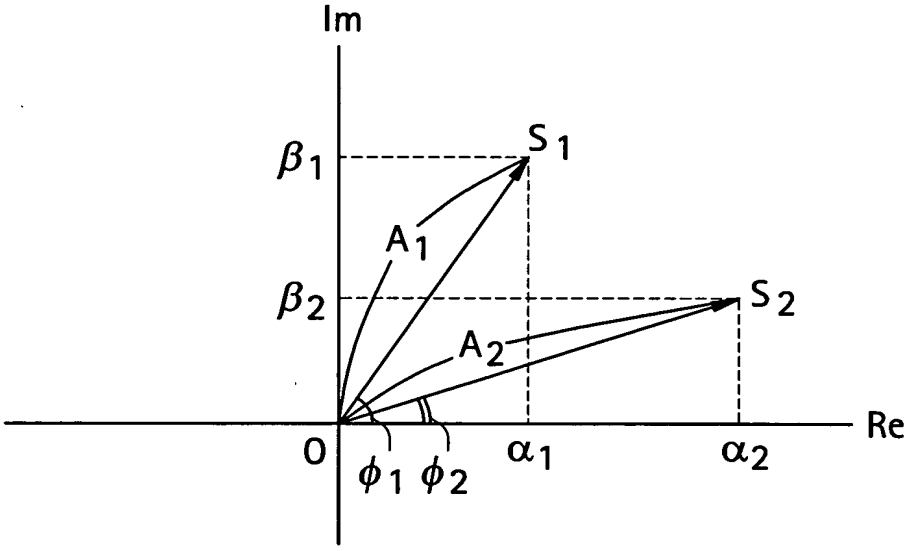

FIG. 5A

Amplitude image

FIG. 5B

Phase image

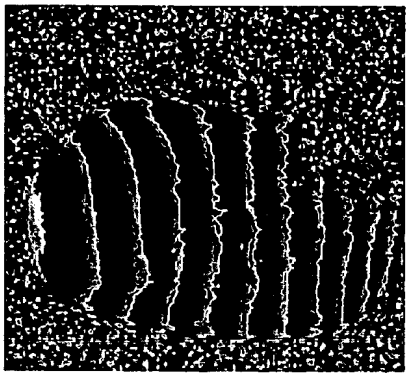

FIG. 5C

Real-part image

FIG. 5D

Imaginary-part image

FIG. 5E

Normalized real-part image

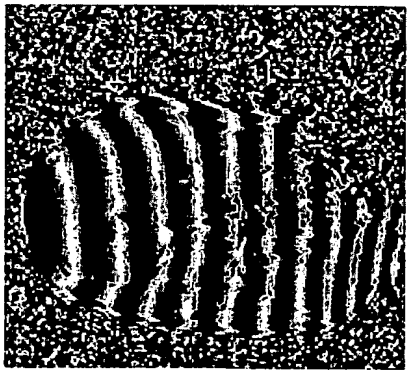

FIG. 5F

Normalized imaginary-part image

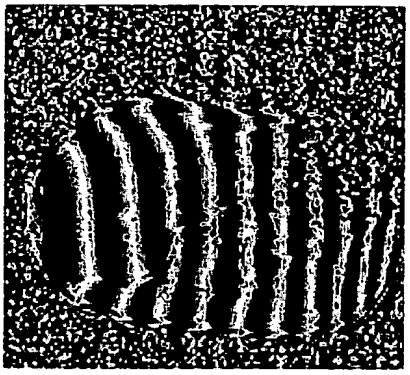

FIG. 6

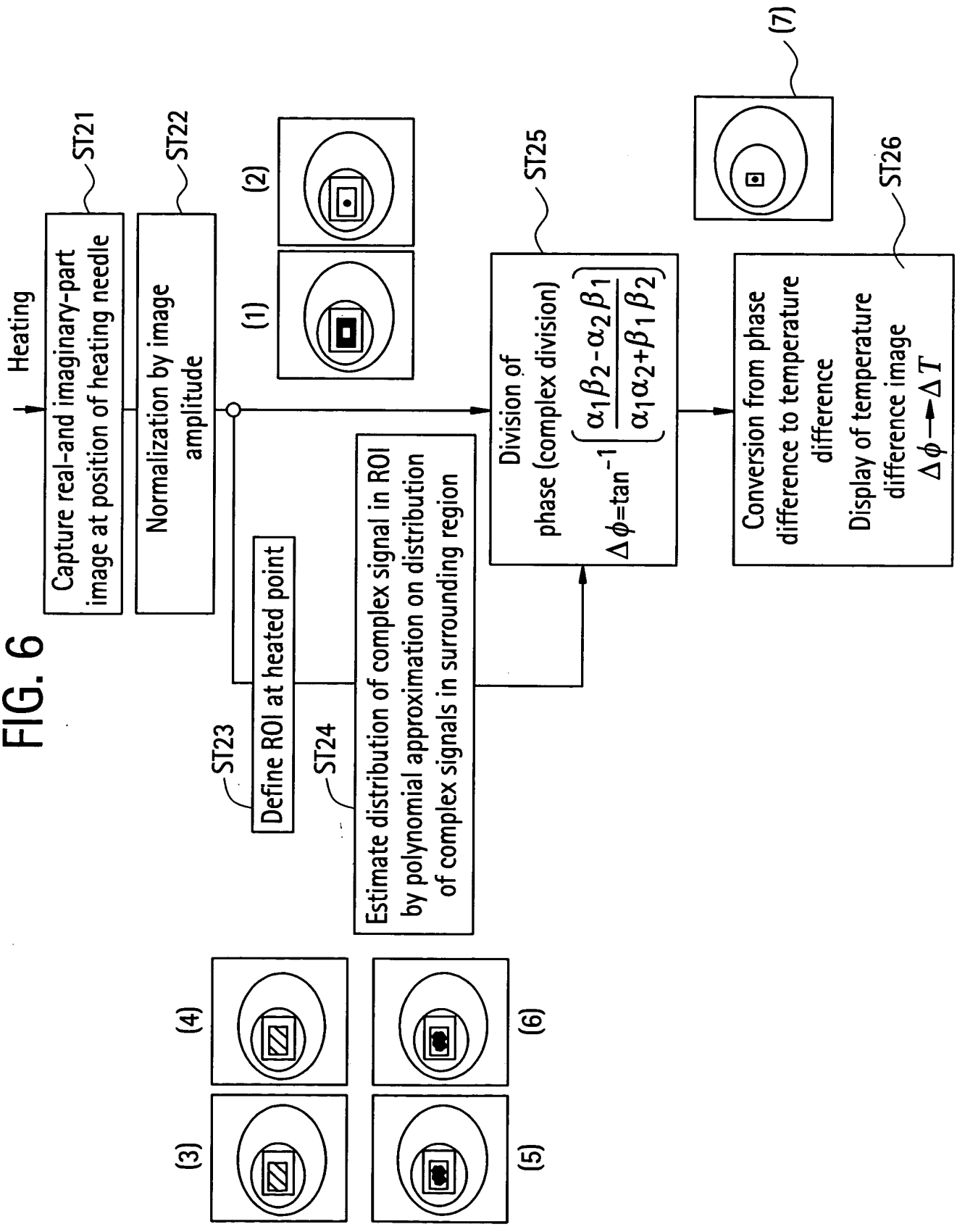
Heating
ST21
Capture real-and imaginary-part image at position of heating needle
ST22
Normalization by image amplitude
(1)
(2)
ST23
Define ROI at heated point
ST24
Estimate distribution of complex signal in ROI by polynomial approximation on distribution of complex signals in surrounding region
(3)
(4)
(5)
(6)
ST25
Division of phase (complex division)
$\Delta\phi=\tan^{-1}\left(\frac{\alpha_1\beta_2-\alpha_2\beta_1}{\alpha_1\alpha_2+\beta_1\beta_2}\right)$
(7)
ST26
Conversion from phase difference to temperature difference
Display of temperature difference image
$\Delta\phi \rightarrow \Delta T$

FIG. 7

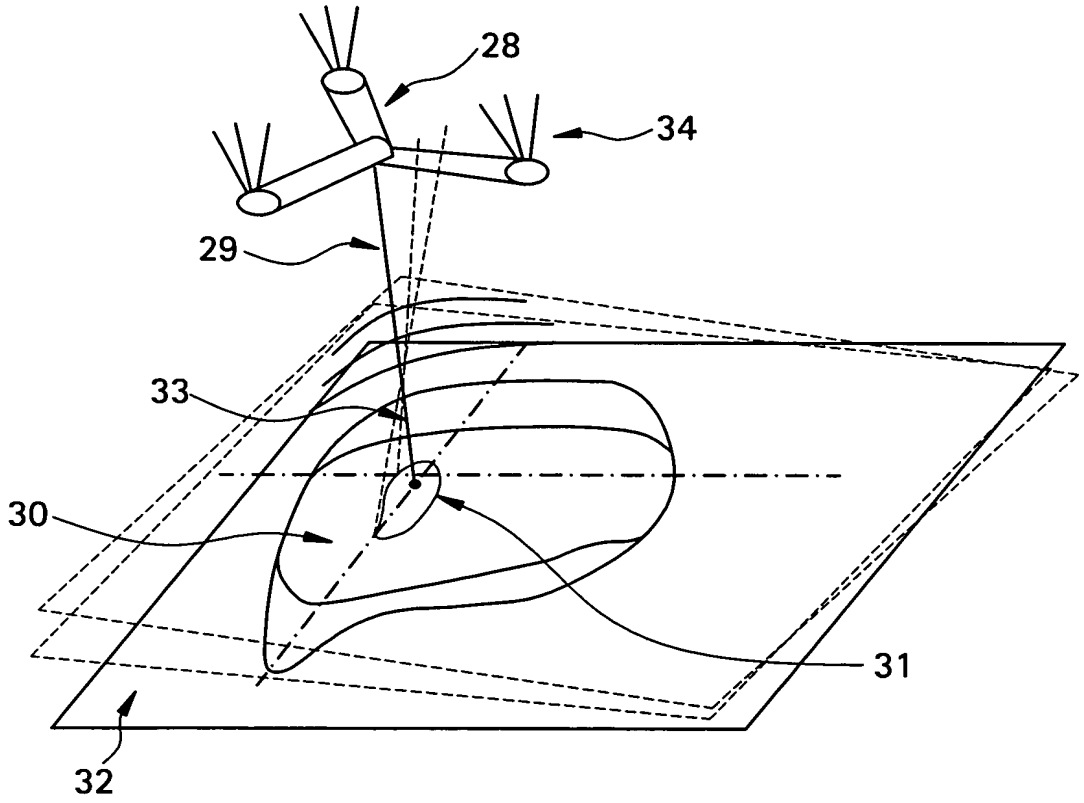

FIG. 8A

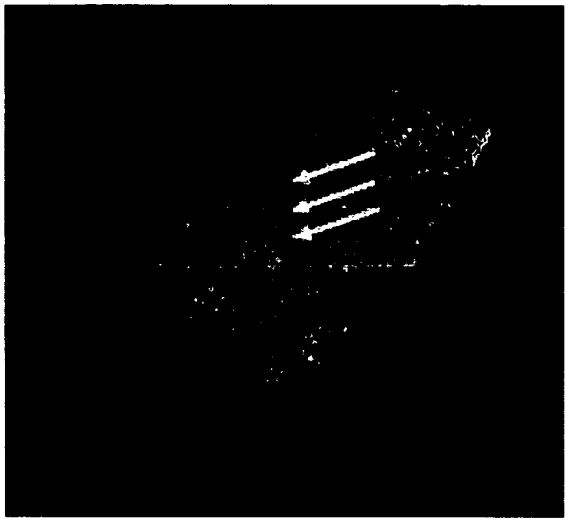

FIG. 8B

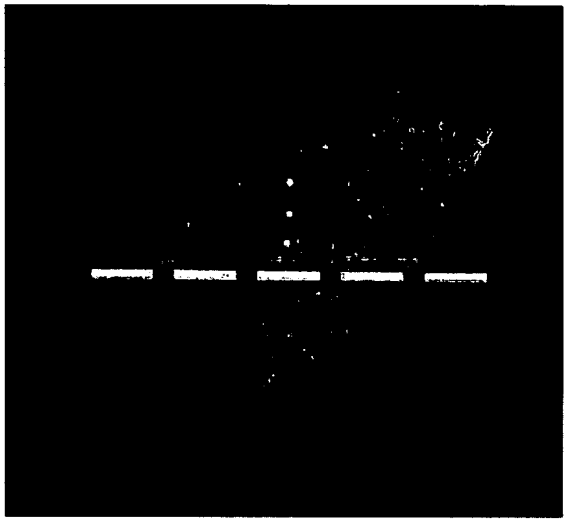

FIG. 8C

FIG. 9A

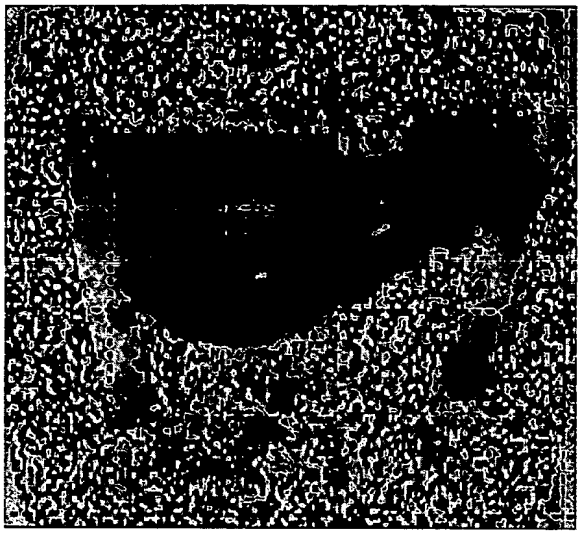

FIG. 9B

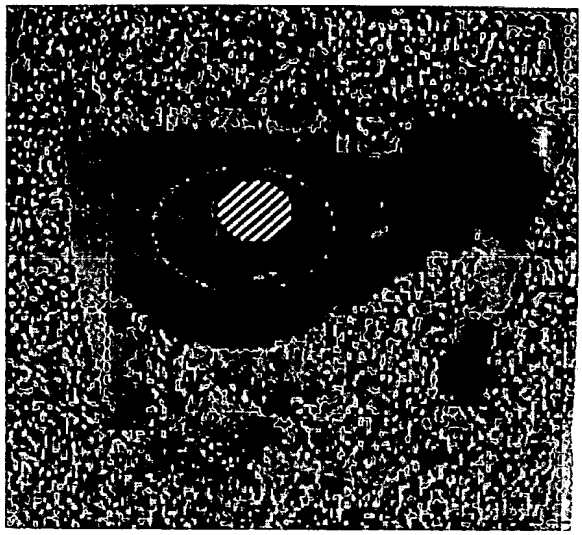

FIG. 9C

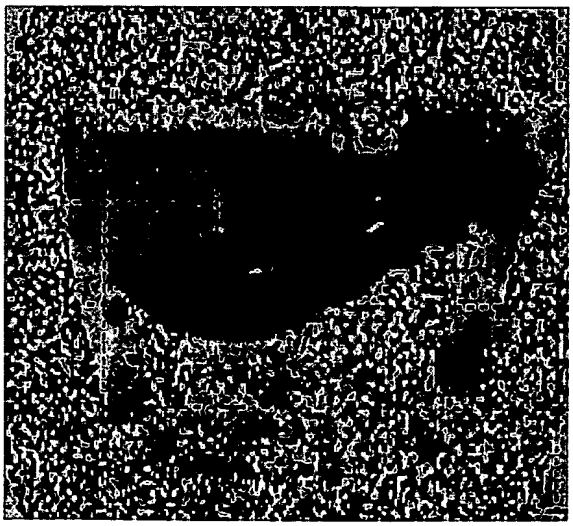

FIG. 9D

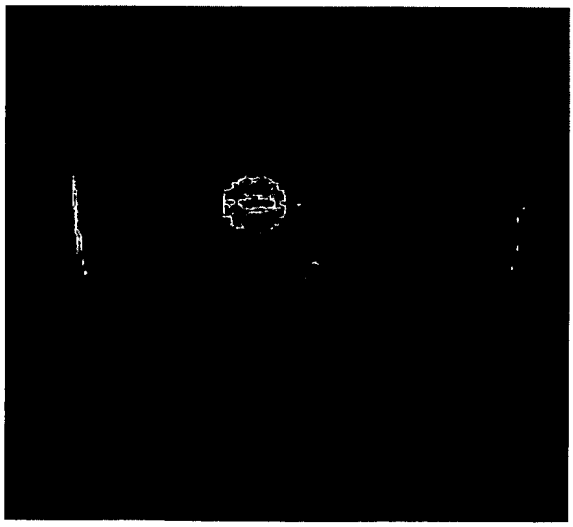

FIG. 10A

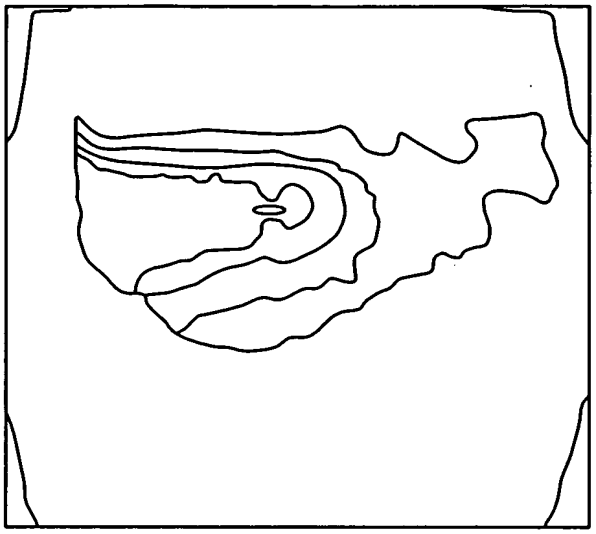

FIG. 10B

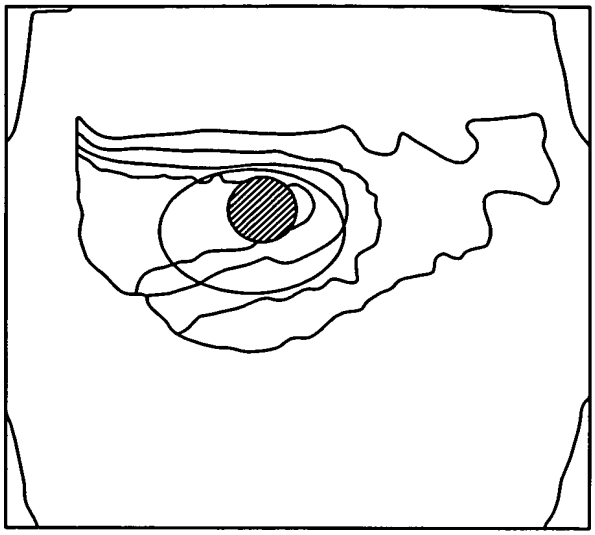

FIG. 10C

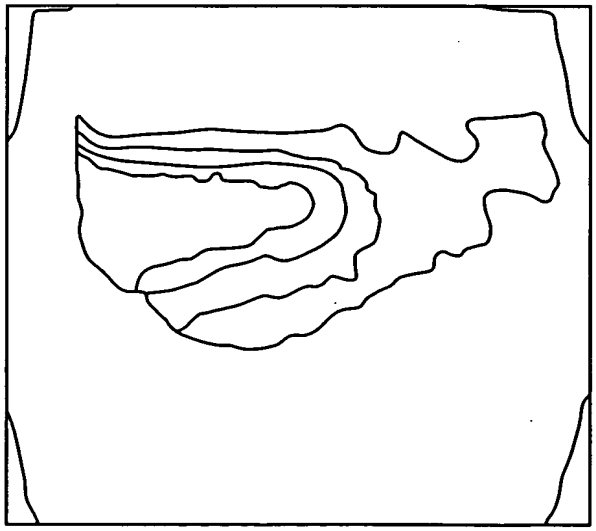

FIG. 10D